REMARKS

In view of the above amendments and the following remarks, reconsideration of the rejections and further examination are requested. Upon entry of this amendment, the specification is amended, the abstract is amended, claims 2-5 are amended, and claim 1 is cancelled, leaving claims 2-5 pending with claim 2 being independent. No new matter has been added.

Substitute Specification

The specification and abstract have been carefully reviewed and revised to correct grammatical and idiomatic errors in order to aid the Examiner in further consideration of the application. No new matter has been added.

Rejections Under 35 U.S.C. §112, second paragraph

Claims 2-5 have been rejected under 35 U.S.C. §112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

The Examiner states that the meaning of the limitation "in consideration of criticality control with geometrical control" is unclear. Claim 2 has been amended to delete this element.

The Examiner states that the geometrical, vertical arrangements of the annular anode and the rod-shaped cathodes are not clear. Applicants respectfully traverse this rejection and submit that one of ordinary skill in the art would understand the recited arrangement. Applicants have clearly defined these terms in the specification. In particular, the annular anode is placed in a horizontal manner relative to the bottom of the electrolytic vessel and, on the other hand, the rod-shaped cathodes are placed in a "vertical" manner such that the rod-shaped cathodes are extending longitudinally towards the annular anode, with a space therebetween. In the text of the present application, the relationship between the rod-shaped cathodes and the annular anode is represented by the wording "vertical" relation. Applicants request that since this relationship is clearly defined in the specification and since the Applicants can be their own lexicographer, that

the rejection with respect to this element be withdrawn.

Additionally, the spent nuclear fuel that is to be processed by the electrolytic vessel in the present invention is placed above the annular anode on the bottom thereof, and therefore in the simultaneous electrolytic step, the uranium oxide contained in the spent nuclear fuel is dissolved into the molten salt by anodic oxidation reaction, and simultaneously recovered as uranium oxide on the surface of the cathode by cathodic reduction reaction.

Accordingly, the annular-shaped anode that can easily be contacted with the spent nuclear fuel by its annular-shaped structure is relatively important and material to the present invention. Further, in order to provide a "paired" configuration relative to the annular anode, it should be noted that the rod-shaped cathodes are inevitably positioned at the upper portion in the electrolytic vessel.

Therefore, Applicants submit that one of ordinary skill in the art would understand the meaning of this claim element.

The Examiner states that the scope of the limitation that the parallel pair of the electrodes is used for auxiliary electrolysis whose role is to suppress the ununifonn uranium oxide electrodeposition is unclear. Applicants respectfully traverse this rejection and submit that one of ordinary skill in the art would understand the recited arrangement. In particular, the parallel pair of the electrodes is used for auxiliary electrolysis whose role is to suppress the ununifonn uranium oxide electrodeposition. Applicants submit that there is a correlation between the electric current (current density) on the cathode surface and the deposited (that is, a thickness of the electrodeposition) of the cathode. The current density on the cathode surface, obtained by electronic computer, and the thickness of the actually obtained electrodeposit were found to be correlated with each other and the correlation thereof is acknowledged as being of proportional relation. This has been acknowledged by a technical literature entitled "Development of Advanced Pyrochemical Electrolyzer (9) - Evaluation of UO_2 Electrolytic Deposition on Cathode-", a copy of which with an English translation is attached herewith.

Thus, in order to restrict an ununiform deposition of uranium oxide to the cathode by the constant thickness of the deposited material, care should be taken so that the current density on

the surface of the cathode is constant. The current density on the surface of the cathode is influenced by, for example, structural features and dimensional features.

When a main electrode is formed by the upper-lower installation of electrodes, the current density of the cathode surface can be uniformed by the following two effects, by utilizing the parallel-installed electrodes as an auxiliary electrode.

1) When only the upper-lower installation of electrodes is used, the current density of the cathode surface decreases in the upward direction, with the largest current density being present at the bottom portion. Consequently, in case of the upper-lower installation of electrodes, deposits appear at the lower portion of the cathode only, and the upper portion of the cathode is not available for an electrode. However, by the addition of an auxiliary electrolysis utilizing the parallel-installed electrodes of rod-shaped cathodes and rod-shaped anodes, a current density at the upper portion of the rod-shaped cathodes can be raised and a current density at the lower end portion of the rod-shaped cathodes can be lowered and, consequently, the difference in the current densities, along the upper-lower (vertical) direction, of the rod-shaped cathodes is reduced. This is shown in Figure 5 of the present application.

2) When the rod-shaped cathodes and rod-shaped anodes are installed in a parallel configuration and the rod-shaped cathodes are rotated to enable a constant distance between the cathodes and the anodes, a current density on the surface of the rod-shaped cathodes will be constant. This results in a minimization of the difference between current density of the rod-shaped cathodes in the circumferential. This refers to Figure 6 of the drawing in the present application.

Therefore, Applicants submit that one of ordinary skill in the art would understand the meaning of this claim element. Applicants also note that this element has been amended to clarify the meaning thereof.

The Examiner states that it is not clear what "MOX recovery step" stands for in claims 4 and 5. Claims 4 and 5 have been amended to overcome this rejection. Additionally, Applicants submit that the term MOX recovery step is clearly defined in the specification.

The Examiner states that "the oxides of uranium and plutonium" and "the electrodeposit fallen down from the cathodes" in claims 4 and 5 lack antecedent basis. Claims 4 and 5 have been amended to overcome this rejection.

Additionally, the Examiner states that it is unclear why the electrodeposit falls down from the cathodes. Applicants submit that one of ordinary skill in the art would understand this claim element. This element is discussed in paragraph [0010] of this application's specification. More specifically, in the industrial field of electrodeposition, as well as plating of metals such as copper and aluminum, metal-state deposits appear on the cathode surface, and thus a strong adhesive force relative to the cathode surface is obtained. Consequently a "falling down" of deposits is minimal after the deposition. In the present invention, on the other hand, uranium and plutonium are in the form of oxides and granular deposits having a size of several mm appear on the surface of the rod-shaped cathodes. Thus, an adhesive force relative to the cathodes and between the granular deposits is extremely small, resulting in the likelihood of falling down of the deposits. Such falling down of the electrodeposits has been acknowledged by the experiments using uranium oxides, as shown by the aforementioned technical literature entitled "Development of Advanced Pyrochemical Electrolyzer (9) - Evaluation of UO_2 Electrolytic Deposition on Cathode-".

Therefore, Applicants submit that one of ordinary skill in the art would understand the meaning of this claim element.

Rejections Under 35 U.S.C. §102(b)

Claim 1 has been rejected under 35 U.S.C. §102(b) as being anticipated by Sharma (U.S. 5,427,657).

This rejection is moot, since claim 1 has been cancelled.

Rejections Under 35 U.S.C. §103(a)

Claims 2 and 3 have been rejected under 35 U.S.C. §103(a) as being unpatentable over Hayashi et al. (U.S. 6,793,894) in view of Gay et al. (U.S. 5,650,053).

Applicants submit that the claims as now pending overcome the cited prior art. Specifically, amended independent claim 2 recites an electrolytic apparatus for use in an oxide electrowinning method, the apparatus comprising an annular anode installed at the bottom of an annular space formed in an annular electrolytic vessel, rod-shaped anodes and rod-shaped cathodes installed along the axial direction in the annular space, a first electrolysis controller connected between the rod-shaped cathodes and the annular anode, and a second electrolysis controller connected between the rod-shaped cathodes and the rod-shaped anodes.

In the oxide electrowinning method to which the present invention is directed, the anodes and the spent nuclear fuel are directly in contact with each other because, during simultaneous electrolysis, only uranium oxide in the spent nuclear fuel is dissolved into the molten salt due to anodic oxidation. Thus, as recited in the apparatus of claim 2, the annular anode is located at the bottom portion of the electrolytic vessel. Therefore, the spent nuclear fuel which has a larger specific gravity than the molten salt effectively and directly contacts the anodes.

The structural feature described above is not disclosed nor rendered obvious by the cited prior art. In particular, Applicants submit that Hayashi discloses a structure in which a rod-like anode 12 extends from the top of a vessel containing an electrolyte. This structure, however, is not suitable for direct contact between the anode and the spent nuclear fuel. Additionally, there is no reasoning in the prior art to modify Hayashi such that it would have rendered claim 2 obvious.

Applicants submit that Gay does not overcome the deficiencies of Hayashi. In particular, Gay discloses rotation of the cathode, which however is quite different from the technical purposes of the present invention. Namely, in Gay, scraper elements 58 are provided to remove deposited uranium from the cathodes. This is the reason the cathode is rotated. By contrast, the present invention uses the rotation of the cathode for the purpose of preventing ununiform distribution of the electrodeposit.

Additionally, Applicants submit that the present invention is also allowable over Sharma. Sharma discloses a structure in which a rod-like anode extends from a top of the vessel

12 containing the electrolyte 14. This anode structure, however, is not suitable for "direct contact" between the anode and the spent nuclear fuel. Here, it should be noted that the uranium oxides have a very low electrical conductivity, and therefore oxidation dissolution is not achieved unless the anodes are in direct contact with the spend nuclear fuel. Additionally, there is no reasoning in the prior art to modify Sharma such that it would have rendered claim 2 obvious.

Applicants submit that the cited prior art does not disclose or render obvious each of the elements of independent claim 2.

Therefore, Applicants submit that claims 2 and its dependent claims are allowable over the cited prior art.

Conclusion

In view of the foregoing amendments and remarks, all of the claims now pending in this application are believed to be in condition for allowance. Reconsideration and favorable action are respectfully solicited.

Should the Examiner believe there are any remaining issues that must be resolved before this application can be allowed, it is respectfully requested that the Examiner contact the undersigned by telephone in order to resolve such issues.

Respectfully submitted,

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